The Chemical Age
A Weekly Journal Devoted to Industrial and Engineering Chemistry
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THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited
VOL. XLIV. No. 1139 April 26, 1941 Annual Subscription, 21s. Overseas, 26s.

Discovery and Invention

A CHARACTERISTIC of the present age is the utilisation in industry of principles, properties and products revealed by scientific research; in consequence, the combined work of discoverers and inventors has now invaded every craft, every art, and every industry, and has changed, and is changing, social conditions. Discovery and invention are thus of intimate interest to every one, and it was wise of Sir Richard Gregory to choose this subject for his Aldred lecture to the Royal Society of Arts. Sir Richard discussed subjects that should be given wide publicity and raised problems, perhaps unwittingly, that are of a difficult and perhaps insoluble character.

Industry, and the chemical industry no less than others, is composed of men of widely varied educational background. The training of some is purely financial and business, others are concerned with the sale of goods, others again are engineers, some are chemical engineers, some are chemists, and a few are engaged wholly in research. To weld together these differing types into a team is no easy task, and it is greatly facilitated when they understand one another's language and problems. There may still exist scientific men who claim that their work can have no possible commercial application, and there may even be among them men who are proud of the fact; in their lack of imagination they are as wingless as the dodo, and like the dodo they will disappear from the earth. First-class scientific work may not have apparent technical applications and, as Sir Richard pointed out, very often no one, not even a professional inventor, can at first see applications which a few years later may be obvious to everyone. When Hertz demonstrated in London before the foremost physicists of his day that his waves would pass through space and could be detected at a distance no one suggested any practical application. The multifarious uses of X-rays were not imagined when they were accidentally discovered in 1895 in an apparatus in which they had been produced all unknown for 25 years. Dewar failed to patent the Thermos flask, seeing no practical use for his purely scientific device for reducing the rate of exchange of radiation. Even Edison failed to discover that tungsten, known since 1783, would have solved the problem for which he ultimately found a partial solution in the carbon filament; and although he discovered and patented the Edison Effect in 1883, it was not until 1904 that this observation was directly used by Fleming to construct the first thermionic valve. Examples could be multiplied to show that in invention, that is to say, in industrial research, it is often necessary to pursue the paths of pure science to a degree difficult of comprehension by the commercial man. The successful researcher must have a flair for applying the results of pure research. Such men are rare, but the faculty may be latent; how can it best be brought to the surface?

This is the fundamental problem raised by the history of the application of research over the past century. The names of Watt, Cort, Huntsman and Arkwright recall that in the early days of the industrial revolution men invented new processes and machines either to solve a problem that handicapped their daily work, or in the endeavour to make their fortunes. The names of many a scientist who has laboured in the "pure" field bear witness that for some the love of their work is sufficient. There are others, and they are in the majority, who follow the calling of research worker partly because they like it, but essentially—if they are ambitious—to "get on" in the world.

The problem of the "remuneration" of research workers is peculiarly difficult. Because it has always been assumed that monetary rewards were the outstanding spur to all men, many mistakes in psychology have been made. Nevertheless, the monetary aspect cannot be neglected, and the remuneration of research workers is a very live subject. When a paid research worker makes a discovery as a result of his work, it was stated to be the Government view that the patent must belong to the Department or Association and that the individual should not benefit directly. Some maintain this to be wrong in principle; it does not encourage the worker to search for practical applications. He must have a spur to excite his imagination, though often he does not recognise that this is so. In practice there is often the difficulty of deciding how far an invention is the work of individuals in a team. Far less than justice may be done by awarding the praise and emoluments, if any, to the leader of the team. In practice, therefore, monetary awards must have serious drawbacks, and to this problem there has been found no complete solution. Perhaps the solution lies in placing a real leader at the head of the laboratory—a man who can inspire others with the enthusiasm he himself must feel if he is worth his place; in providing monetary rewards in the shape of liberal salary increases to those who distinguish themselves; and in allowing the lights that burn brightly to shine beyond the laboratory, thus giving honour where honour is due.

NOTES AND COMMENTS

The Industrial Laboratory

ON a later page of this issue we print an article on thirty years of progress in the industrial chemical laboratory, by an authority of wide and varied experience in the industrial chemical world. The years described have indeed been years of progress, and the chemist is now generally rather looked up to as a person of importance and authority, not as a sort of by-product of the works, evil-smelling, but somehow inevitable. It is true, as the author points out, that there are still in existence works laboratories where the luckless chemist has to carry out research operations, both routine and special, in conditions that would drive a man well nigh crazy if he were not truly devoted to his work. But one advantage of the creation of large chemical firms and of associations for chemical research is that the authorities in control of them know that their chemists, like their other employees, work best best under clean and unhampered conditions. Even there, of course, the research chemist cannot expect quite the academic calm of a university laboratory; but that is all to the good. The industrial chemist is a scientist, granted; he may even be a theoretical scientist in his spare time, such as it is; but above all he must learn to be a practical worker in the business of life. And in these times especially it is the chemist capable of combining the scientific and the practical outlook in one, who is going to strike the hardest blow for the eventual victory of our science over the enemy's.

Military Service and the Chemical Industry

SO widespread are the ramifications of the chemical and allied industries nowadays, that it is impossible to make a generalised statement on the extent to which they are all affected by the new *Schedule of Reserved Occupations and Protected Work* (H.M. Stationery Office, 1s.). As we stated briefly in our last issue, the conditions for workers included under the official head of " Chemicals and Galenicals Manufacture (including Drugs) " are unchanged. Certain allied industries, however, are diversely affected, and it would be wise for those concerned with such trades to purchase a copy of this inexpensive pamphlet. For example, in the manufacture of artificial manure and fertiliser, and of asbestos cement goods, the reservation age for various groups remains the same in the first two stages, A and B; when stage C is reached, however, the age of reservation is advanced by five or ten years. Men under the reserved age at stage A are liable to be called up immediately; those de-reserved at stages B and C will not as a rule be called upon to join their units before mid-July and October 1, 1941, respectively. Paint, pigment, soap, and gelatine manufacture are other trades affected by the three-stage system of de-reservation. Scientific and research workers, including members of the staff of universities, technical colleges, etc., are still wholly reserved at the age of 25 (21 in the case of analytic and research chemists, post-graduate engineering students, meteorologists, and physicists), and their right to volunteer for service in H.M. Forces is subject to the consent of the Scientific Research Committee.

Arrangements for Students

SPECIAL arrangements have been made for students with certain qualifications. Men under the age of 25, belonging to these classes, may make application to the University Joint Recruiting Boards. The Boards may recommend that such men should engage in technical service in H.M. Forces, or in scientific or technical work of a civilian character, or that they should complete a course of study so as to be better fitted for such service. These include: (i) Men with university honours degrees in the following subjects, among others: engineering, metallurgy, chemistry, physics, biological sciences, agriculture (including forestry), geology, mathematics, statistics, or with university general or pass degrees in two or more of the aforesaid subjects; or with university pass degrees in agriculture, engineering or metallurgy; (ii) Men with the Higher National Diploma or Higher National Certificate in mechanical or electrical engineering, or with the Associateship of the Institute of Chemistry; (iii) Men who have started or are about to start a full-time course at a university, university college, or recognised technical or agricultural college or institution. The reservation of students under the schedule is subject to periodical certification of satisfactory progress in their studies.

Labour Wastage

AN article in the current issue of *Occupational Psychology*, published by the National Institute of Industrial Psychology, analyses some of the causes of labour wastage, absenteeism and unpunctuality in factories under war conditions. Among the causes of labour wastage are the discrepancy between labour supply and demand, the employment of large numbers of new operatives who generally tend to leave sooner than experienced ones, and, thirdly, lowered standards of selection, due to labour shortage and resulting in misfits. The organisation of suitable training schemes can help to reduce the number of starters leaving, both by teaching them their jobs and making them feel at home during the first few difficult days. The use of selection tests can still help in avoiding misfits. In discussing absenteeism, it is noted that women tend to be away more than men, and married women more than single girls. The causes of absenteeism appear, in order of importance, to be home circumstances, illness, and lateness. Among the remedies suggested are the following. Large factories could probably reduce much absenteeism by arranging for their canteens to sell rationed and other foods, and allowing women to make their purchases during the lunch hour. Efforts should be made to avoid excessive hours, and, where additional labour can be got, the organisation of reserves of labour for key positions has good results. Experiments could also profitably be made with short double shifts worked by women whose home duties prevent full-time employment. It is suggested that much can be done to improve interest in work and punctual attendance by incentives such as competitions between shifts and pride in output. The latter is encouraged by visible records of progress, such as figures climbing up ladders. Illustration is also given of good results obtained by "punctuality drives."

Iodine and Food Supply

HOW to treat some of the common animal diseases that reduce the nation's war-time supply of home-grown food is described in a brochure entitled "Better Animal Health," which has just been published in London by the Iodine Educational Bureau. The book contains more than fifty scientific articles on the treatment of sterility, abortion, fowl paralysis, lumpy jaw, wooden and timber tongue, joint-ill and various other diseases that cause heavy economic losses. Recalling the recent estimate of the National Veterinary Medical Association that four dairy cattle diseases alone are costing the country £20,000,000 a year, the Bureau points out that the resulting waste of dairy products, if eliminated, would provide three more pints of milk per week throughout the year for every child up to 15 years of age. The loss is equal to an extra 2 oz. weekly butter ration for everybody for nearly three months in twelve. In fact, these dairy cattle diseases are costing Great Britain one-ninth of the total amount we spent to import meat and dairy products in the last year before the war.

THE U.S. CHEMICAL INDUSTRY is ready for any demands, according to Dr. Hugh Taylor, head of the chemistry department of Princeton University. Addressing the American Chemical Society at St. Louis, Dr. Taylor said that the petroleum industry would take care of its conceivable normal needs, which included high-grade fuel and would serve the explosive and rubber industries with essential raw materials. He went on to say that the methane resources of the nation were so large that an enormous chemical industry could be based on its proper utilisation.

THE SPECTROGRAPH IN INDUSTRY

Its Development and Uses in the Works Laboratory

by DAVID L. MASTERS. M.Sc., Ph.D.

BROAD generalisations are frequently risky. It is fairly safe, however, to say that the two broad fields of analytical chemistry in which there have been the greatest developments ever the last twenty years have been those utilising micro-technique, and those where the services of the spectrograpn have been utilised. It is worth while to carry the parallel further in a brief way.

Both branches had their inception during the latter half of the nineteenth century. They then fell practically into disuse, and were rehabilitated in popular favour roughly within the last twenty years. Both are largely concerned with the analysis of small quantities of material, or of impurities present in very small amount. And both may lay claim to considerable advantages over the older methods in the saving of time and money.

The use of spectroscopic methods in chemical analysis used to be termed "spectrum analysis." Since this term may now lead to some confusion, owing to its utilisation by physicists in another connection, the name "spectrochemical analysis" has been suggested by Andrade.[1] This is unambiguous, and has an apt and obvious parallel in "microchemical analysis" —a parallel which is justified by the historical similarity and the common aims already mentioned.

Early Development

It is to the instrument maker that we are indebted in large part for the widespread uses that can be made of spectrographic methods in industry to-day.[2] Probably no single instrument—certainly no single optical instrument —has proved itself to be so valuable, both in the pure and the applied sciences. We are not here concerned with the extensive knowledge of the structure of matter, or of the composition of the universe, obtained by the investigation of spectra; although these points should be borne in mind when assessing the importance of spectrography. From a more purely chemical point of view, it is worth noting that at least six elements were first detected by spectroscopical means; and this fact leads us naturally towards the remarkable potentialities inherent in spectrochemical *qualitative* analysis.

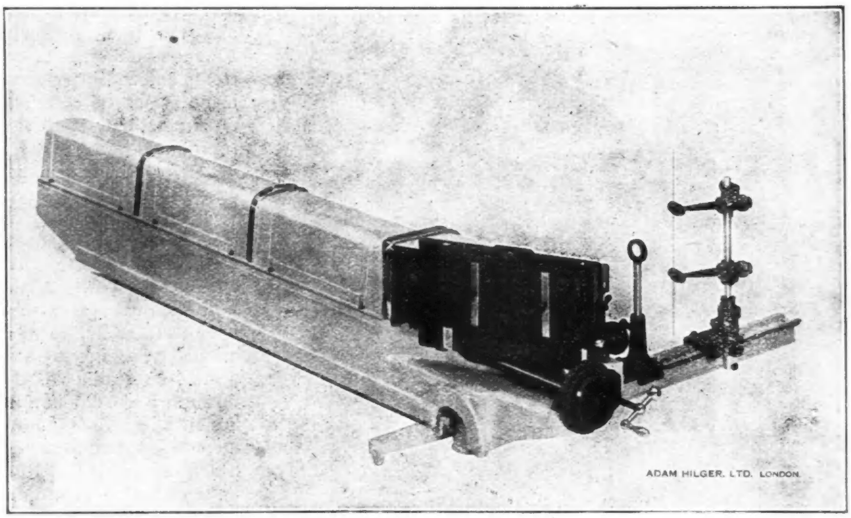

Fig. 1. Hilger fully automatic long quartz spectrograph (Littrow), with bar case and spark stand and condensing lens

When Kirchhoff and Bunsen[3] concluded from their researches that every element, if excited under suitable conditions, emitted light of certain definite wavelengths, and that these wavelengths were a fundamental characteristic of the element in question, they admittedly laid the foundation of spectrochemical analysis. The work of such people as Hartley,[4] and later Pollock and Leonard,[5] rapidly covered this field as far as was possible at that time, and it is noteworthy that much of their work is still of first-rate importance. The tables of ultimate lines prepared by them[6] are lasting monuments to their skill in handling instruments which, from the modern point of view, can at best be termed unsatisfactory and crude.

The qualitative applications of the spectroscope had only a limited usefulness. As was natural, attempts were made to open a much wider field by adapting the methods to quantitative analysis. Hartley, soon after 1880, utilised the fact that not only is the wavelength of light emitted characteristic of the element, but that the intensity is also related to the proportion of the element present in the sample under treatment. It was in developing this work that the limitations of the age were felt. When an investigator most probably had to prepare his own prisms and lenses—in fact, manufacture his own instrument out of costly material with time-consuming labour—neither satisfactory now quick results could be expected. In addition, methods could not be satisfactorily duplicated, so that the relation between intensity and concentration had only a very shadowy validity. Finally, there was not sufficient appreciation of the relative advantages and disadvantages of the different methods of excitation known at that time.

Three things were required—the development of instruments, of technique and of knowledge—before any real advance could be made. It is quite certain that the appeal of spectrochemical methods could not be felt in industry under the conditions outlined above. This is a far cry from the position to-day, when it is certain that there are few chemical industries where the spectrograph can have no useful place, and many where it may be considered indispensable.

The Spectrograph

The primary development, on which all the others had perforce to wait, was that of the spectrograph itself. It is difficult even now to assess the debt owed to those optical firms which devoted themselves, either wholly or considerably, to the production of spectrographs and spectrographic accessories as a commercial proposition. While the most notable advance in the history of these instruments was undoubtedly the introduction of the quartz spectrograph, the more recent developments are also worthy of note. It is axiomatic that for a good spectrograph the optical work must be good. But it is satisfactory to note that spectrographs are now being produced which have two further attributes considered in their manufacture.

One of these is ease of handling. The older instruments, particularly those of the Littrow type, were "temperamental," requiring a considerable amount both of experience and of technical ability for their use. Now it is no empty boast that a trained laboratory assistant can use one of the modern "automatic" instruments for routine analyses as capably as

an experienced research chemist, with, at the same time, a welcome reduction in working time. Therein, undoubtedly, lies one of the great attractions of the instrument for chemical industry.

The other point, at first sight minor in comparison with efficiency, is appearance. There is, however, no logical reason why a valuable instrument should also be either ugly or badly designed. Indeed, there is no excuse for such a state of affairs. Unfortunately, it seems that design from this point of view was relegated, in the early days, to a very back seat. Comparison of an instrument of 1920 with a corresponding one of 1940 will show the strides that have been made in this direction. In a good modern spectrograph we have one of the finest examples of artistic design in scientific instruments. It may appear hypercritical to value a precise instrument as an example of laboratory furniture. But quite apart from utility there is an inherent satisfaction in the handling of beautiful instruments which is no mere illusion.

Broadly speaking, three classes of spectrograph are available at the present time which are of interest to the chemist—large, medium and small. The choice of instrument will be largely dictated by the nature of the work to which it is to be applied. For analysis dealing principally with steels or the metals with complex spectra (*e.g.* the so-called transition elements) a large spectrograph is essential. Usually one of the Littrow type is employed, which gives an approximate dispersion of 30 inches for the range 8000 Å. to 2000 Å. For the non-ferrous elements with simpler spectra—that is, mainly those elements occurring in the groups I to III of the Periodic Classification and some of the group IV and V elements, either a medium or a small type spectrograph will be found suitable. Which of these is used will depend principally on the precise combination of elements expected. Naturally the medium type will be more useful as a general purpose

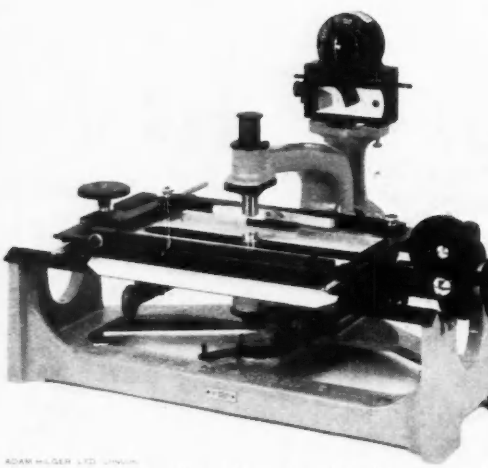

Fig. 2. Non-recording photoelectric microphotometer

instrument, since it combines simplicity of handling with adequate dispersion (roughly 10 inches for 8000 Å. to 2000 Å.) However, it is possible to do an amazing amount of good work with a small spectrograph, covering much the same range on, say, a five or four inch plate. Such an instrument is competent when dealing with elements giving a simple spectrum with strong lines in the region 3000 Å. to 2000 Å.

Outside these three main classes, for more specialised work, there may be mentioned the grating spectrograph[7, 43, 64, 65] and the micro-spectrograph.[8] The former cannot yet be termed a popular instrument with chemists. It is possible, however, that for very precise quantitative work it will receive more favour in the near future. The latter has found some application in the microscopic examination of the spectrum from very small specks of foreign material in a larger mass. Apart from this, its main field up to the present has been in absorption work.

So much for the spectrograph itself. We now come to the developments in other directions which have made quantitative spectrography a practical possibility. These may be grouped as (1) standardisation of the method of excitation of the spectrum; (2) standardisation of the treatment of the photographic plates after exposure; (3) choice of the correct method of excitation; (4) special techniques; (5) accessory instruments which control the light falling on the plate; and (6) accessory instruments of the photometer type, which measure the intensity of the lines of the spectrum. Of these (1) and (2) are mainly mechanical advances and space does not allow of their being dealt with in any detail here. Further information may be found in recent text-books dealing with the practice of spectrography.[9-14]

Methods of Excitation

An emission spectrum may be produced by the application of a flame arc or spark to the material under test. (This, of course, neglects discharge-tube spectra, which have only a limited interest for the industrial chemist).

Of the flame methods, two in particular deserve special note, the Lundegardh method[15, 16] and the Ramage method.[17, 18] Lundegardh injects a spray containing a solution of the substance into an air-acetylene flame. This method has the advantage that it can be controlled carefully—a fixed amount of solution can be sprayed under standard conditions over a fixed time, so that reproducibility is high. Ramage bases his method on the burning of the material in a rolled filter paper in an oxy-coal gas flame. In later work, the method has been made more sensitive by the addition of an arc in the flame above the ashed specimen. This naturally produces greater excitation. Both methods have shown themselves to be particularly useful in biological applications[19]—the determination of trace elements in animal tissues, or in soils, plant tissues and the like. A further interesting development of the Ramage method is to be found in the work of Roach.[20] Pretreatment with ammonium chloride, thus converting the salts to chlorides, is claimed to make the method not only more sensitive, but also to approach more nearly to precise reproducibility.

Leaving flame methods, we now turn to the arc method of excitation. The ordinary direct current arc has, of course, been one of the most utilised methods of obtaining spectra. One of its disadvantages is irregular burning, and many methods of reducing this have been used. The poles may be cut in such a way as to force the arc to concentrate always in the optical axis of the spectrographic system, thus avoiding irregularities due to the tendency of the arc to wander.[21] The method of supplying the test material—say in solution form—may be standardised by dropping it at a constant rate through a special hollow electrode,[22] or by impregnating the arc in a carefully controlled fashion.[23] Another interesting method, applied to the use of iron as a standard by Slavin,[24] is based on a modified Pfund arc. In this, the iron is not used as a complete electrode. Instead, a small bead of iron is "seasoned" in the cavity of a graphite electrode, and it is claimed that such an arc is very easy to control.

With the ordinary d.c. arc, the practice has been to use only a very small portion of the image from the centre of the arc,[9] and to place the specimen on the positive (lower) pole. This procedure may advantageously be modified under certain circumstances, as has been shown by the work of Mankopf and Peters.[25] In the modified method, the lower pole carrying the specimen is negative. The portion of the arc used for the spectrum is the "cathode layer," 1 to 2 mm. from this pole. When small quantities of sample, of the order of a few milligrams, are used, the intensity of the emission for many metals is increased considerably. So that the method is particularly suitable for trace analysis.[26] On the other hand, the normal arc method is most suitable for high melting alloys, refractories, and similar substances, when a reasonable amount of material is available. The high voltage a.c. arc has become more familiar in recent years.[27, 28, 43] Using about 2000 volts, and up to 6 amps., it gives very easily reproducible conditions. It is applicable to

very small quantities, since it is extremely sensitive and does not give a dense continuous background to the spectra.

The remaining important method of excitation may function either as the high voltage a.c., or as the low voltage d.c. condensed spark.[27, 43] Both of these have advantages in the comparatively low temperature and freedom from continuous background, and both are suitable for minute quantities. The condensed spark has frequently been employed ingeniously for the analysis of small foreign specks on larger metal surfaces, since the damage to the surface is much less than would be the case with the arc. Two recent applications of the condensed spark are of interest. It has been used in systematic analysis for the control of precipitation in the various groups.[29] It has also been combined with electrolysis. An amalgamated copper wire is the cathode for electrolysis of the unknown solution, and then becomes one of the spark electrodes.[30] This ensures that materials originally present in very small amount will be sufficiently concentrated to give a strong spectrum.

Special Techniques

Three of the special techniques in quantitative analysis, out of the many that have been proposed, may be mentioned here. The first is the now well-known internal standard method by means of homologous pairs.[11, 14] By this method, close pairs of lines are chosen. In each pair, one line belongs to the principal constituent of the mixture, whose content may be considered to be constant, owing to its large excess. The other line belongs to the variable minor constituent. By measuring the relative intensities of these homologous pairs, the percentage of the minor constituent may be determined.

The second method is the outstanding advance of Judd Lewis in the Ratio Quantitative system.[31] He realises how

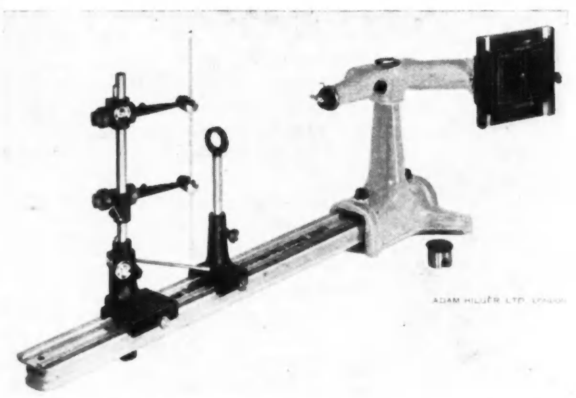

Fig. 3. Hilger-Barfit small quartz spectrograph with standard accessory bar, Gramont arc and spark stand, and condensing lens

strict must be the control in cases where percentage is determined by comparison with synthetic standards. To illustrate this, we may consider three metals, A, B and C. If it is required to determine the percentage of B in A, when one is dealing with a sample containing 1 per cent. B and nothing else, then it is sufficient to compare the spectrum obtained under controlled conditions with those given by a series of prepared standards ranging, say, from 0.01 per cent. to 5 per cent B in A. If, however, a new specimen is being investigated, consisting of 94 per cent. A, 1 per cent. B and 5 per cent. C, then such a procedure is not permissible, since the added 5 per cent. C may radically affect the emission intensities of A or B. It is, therefore, essential that the spectrum of the unknown should be compared with synthetic samples all containing approximately 5 per cent. C. In other words, to obtain the greatest accuracy the final comparison must be made with a prepared standard which duplicates closely the composition of the unknown.[64]

The third method, based on Pollok and Leonard's work, consists in diluting the unknown by admixture of known amounts of "neutral" material. The dilution is noted at

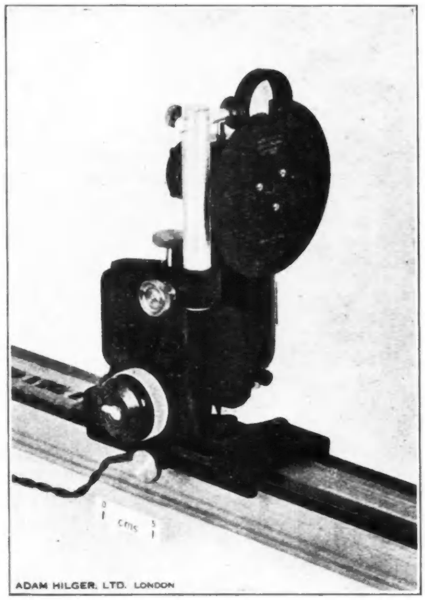

Fig. 4. Rotary logarithmic wedge sector on Barfit stand

which the ultimate, or other chosen lines of the element being determined just disappear. The absolute concentration corresponding to this having already been determined, simple calculation gives the original concentration in the unknown.[32]

The two outstanding methods of obtaining quantitative data by control of the intensity of illumination are by an apparatus of the wedge type,[33, 43] or by one of the rotating sector type.[34] Actually, both of these lead to quite similar results, the principle being that the intensity of a line is in effect determined by decreasing the light which it throws on the plate systematically from end to end of the line. As a consequence, the length of the line is a measure of its intensity, and direct measurement of linear values gives the relative intensities of the lines under question. The only difference in principle between the two methods is that in the former case reduction is ensured by progressive screening of the plate, while in the latter, the time of exposure of the line is altered from end to end by means of a movable diaphragm.[43] Of these two methods, the most useful is undoubtedly the latter, and a number of instruments are now on the market which attain the required result in a variety of ways.

The finest degree of precision in quantitative spectrochemical analysis has been attained by the application of the photometer,[1, 35-37, 65] With its aid it is now claimed that analyses may generally be carried out with an error of ± 2 per cent. of the constituent sought. It must be realised that the absolute error represented by this is usually extremely minute, owing to the fact that investigations of this nature are usually concerned with determination of quantities formerly designated as "trace," and in any case probably not greater than 1 or 2 per cent. In fact, such precision is amazing, when one remembers that chemical methods would frequently be quite useless if applied to the same problem, and that therefore the spectrograph is the only means of obtaining results which are more than approximate.[38]

The photometer used may be either recording or non-recording, and in either case is merely productive of a refined accuracy over that obtained by purely visual comparison in determining the intensities of lines. Although (particularly when considered in conjunction with the initial expense of the spectrograph itself) the cost of a photometer may at first sight appear prohibitive, it is certain that where large numbers of routine analyses are carried out, requiring close control of the amounts of trace elements, the photometer will replay its purchase price many times over.

It would be overlooking one important point if, in the consideration of those advances which have made spectrochemical

methods reliable, we omitted mention of laboratory conditions themselves. It is obvious that when one is using an extremely sensitive instrument the necessity for avoiding contamination is paramount. Attention must therefore be paid to such details as the purity of the air in the spectrographic laboratory. Continuous running of a metallic arc, for example, will soon produce a high concentration of metal vapour in the region of the apparatus, and this must be readily removable. Other problems arise, dealing with ease of working: and the layout of the laboratory should keep these in view from three aspects—use of the spectrograph, photographic operations, and the final process of evaluation of results.[39, 43, 65]

Industrial Applications

Industrial applications are so many and so varied that the only possible course in an article of this scope is to deal very briefly (and inadequately) with a few of them. Various books and articles,[41-48] and many of the references already quoted, provide instances while the whole field of usefulness of spectrochemical analysis has been reviewed from the industrial aspect in a recently published symposium covering some thirty typical industrial organisations.[40] Each of these has described briefly to what extent it uses the spectrograph, and, in many cases why this is preferable to the older methods. Applications range from simple qualitative work on complete unknowns to the most elaborate methods of purity control. The nature of the work varies from metal and alloy analysis to sugar refining and the analysis of water in the fermentation industries.

It is true that, until recently, it was in the metal industries that attention to spectrochemical methods was mainly centred. But the work just mentioned is not alone in pointing out that many other branches of chemical industry, covering pretty well the whole possible range, can also find the spectrograph useful, if not indispensable. For example, caustic liquors are easily examined for impurities whose determination is not feasible by ordinary chemical methods.[49] Plastics and pharmaceuticals are controlled for impurities ranging from 0.0001 per cent. to several per cent.[27, 50]

So far, the examples mentioned have concerned inorganic materials, either in inorganic, or as impurities in organic analysis. Two recent fields have been opened up which suggest that they may have interesting applications after they have been somewhat further worked out. The first of these is an application of Raman spectra.[51] Formerly the only satisfactory method (apart from tesle luminescence spectra) of distinguishing between organic substances spectrographically was by means of absorption spectra.[43, 52, 64] This has had only a limited application in purely analytical chemistry, partly because of the fact that selective absorption is shown only by certain classes of organic compounds, and partly because of the band nature of absorption spectra. As a consequence, when one is dealing with a mixture containing two organic substances, both of which give absorption spectra, it is rarely possible to distinguish sufficiently the separate spectra of the substances. Since, however, the Raman spectrum (which, being closely connected with molecular structure, is as individual as an inorganic emission spectrum) is relatively simple, and in the form of lines, it seems obvious that the recent uses which have been made of it in determining presence or absence of one organic substance in another are quite legitimate, and will ultimately come to have a very wide application.

The other field is in fluorescence analysis.[53, 64] It has been recommended that in no case should a fluorescence colour be described merely by name. It is much more precise, and much more informative, if the light is detailed in terms of wavelength. If this practice is widely adopted, there seems every possibility that the data thus accumulated, particularly in the organic field, will prove to be of great use to the analyst.

Evaluation of Spectra

This article would be inadequate if no mention was made of the means by which spectra, once produced, are identified and interpreted. Brief reference must be made to the tables of wavelengths, maps of spectra, and similar aids, of which there are many. The outstanding addition to this group in recent years has undoubtedly been the wavelength tables compiled by Harrison.[54] These are invaluable, for, while they supplement the much briefer, although essential tables of ultimate or important lines,[6, 55, 56] they are nevertheless not too involved and cumbersome to use. The compilation also contains short tables of sensitive lines, and has an elaborate listing of intensities.

The method of identification by means of maps of spectra cannot complain of lack of aids to-day, for there are such maps as those of standard spectra,[57] maps of the ultimate lines emitted by a large number of elements,[58, 59] and such older, but valuable publications as that of Bardet.[60] Various methods have recently been suggested to make the reading of spectra more rapid. Several of these depend on the use of special plates, prepared according to a fixed plan.[59, 61] One of the most ingenious, for instance, uses a positive plate in conjunction with the negative being examined to determine the presence or absence of certain elements, according as to whether the positive and negative completely balance or not.[62] Another method, which has been widely recommended, is that of enlarging plates to a standard size, equivalent to that for standard maps of spectra already prepared. This method makes the comparison of spectra for the purpose of qualitative analysis a process of extreme ease.

It is realised that this article is extremely sketchy, as must needs be the case when dealing with such a wide (and rapidly expanding) subject. It is, indeed, only in monographs, symposiums and specialised journals that such a topic can be treated with the freedom and spaciousness that its importance warrants. In this connection, and as a fitting conclusion, a suggestion by Twyman[63] is worth recalling. This was to the effect that spectrochemical analysis should receive a more adequate support in this country either by the foundation of a Spectrochemical Society sponsored by a body such as the British Non-Ferrous Metals Research Association, or by the institution of a section of the Society of Chemical Industry dealing with industrial spectroscopy. Undoubtedly there is considerable need for such a body, particularly in order to collect and collate the large amount of material at present published in scattered places. One point needs to be emphasised: the tendency to associate spectrochemical analysis solely with the metal industries, as has been the common attitude for so long, must be combated. As has been stressed in this article, the field need not be limited in this narrow sense. However, better a body founded under such a misapprehension, which could ultimately be erased, than no body at all.

It is unfortunate that war is no breeder of new societies for the promotion and interchange of scientific knowledge. There can be, however, no possible objection to the discussion of plans which, when peace comes, will fill a gap whose extent is most probably not half realised by the majority of chemists in this country, be they analytical in the industrial or the research sense.

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(*Continued on page* 236.)

THIRTY YEARS OF CHANGE

Progress in the Industrial Laboratory

by G. E. FOXWELL, D.Sc., F.Inst.P.

Dr. G. E. Foxwell

THE laboratory is the workshop of the chemist, and as such commonly receives as much or as little attention as is bestowed upon the chemist himself. From this it follows that laboratories show an infinite diversity of types dependent on the nature of the work undertaken, on the personality and drive of the chief chemist or on the outlook or policy of the firm. The research laboratory of a Research Association or a large firm is generally the best equipped of all. There, whatever apparatus is needed for testing purposes or for research is to be found; the whole building is kept clean and the work is done under the very best conditions. It is in a sense reminiscent of the university laboratory. At the other end of the scale comes the small works laboratory which is attached to an engineering works or which has to deal with the routine testing of dirty materials, in regard to which the highest accuracy of measurement is unnecessary. Thirty years ago this type of laboratory was very common indeed, because employers regarded the chemist as an expense of doubtful value. The writer was at that time engaged in the construction of works of a semi-chemical character, and well remembers the fighting spirit that was necessary to persuade those for whom the works were being built to set aside even one small room with a bench for the chemist. Even to-day, and in some firms that are fully alive to the value of the advice which the chemist can give them, it is considered that any building will do as a chemist's shop, and he may have to work amid conditions of dust, noise, vibration, and dirt which entirely preclude the possibility of exact work.

These conditions are heartbreaking to those educated to the facilities and neatness of a university laboratory, but with experience it is still possible for the laboratory to perform its functions even under such bad conditions; so much depends upon what the functions are. If those working in the laboratory refuse to allow the conditions to get them down and keep their workshop clean and tidy, and use their ingenuity to minimise the adverse conditions as far as possible, they will be surprised to find how much good work can still be done under adverse circumstances. Quite a lot of really good apparatus can be home-made by judicious use of bricks, iron pipes, and glass tubes, supplemented by the simpler standard apparatus which can be bought and by some skill in glass blowing. The passing years have seen a good deal of improvement in laboratories, and if the head of a laboratory is sufficiently self-assertive, he can usually obtain a suitable place in which to work and at least the minimum of apparatus required to do his work efficiently.

Standards of Work

Much depends on the realisation that the accuracy of the work must be correlated to the purpose for which the tests are required. There must in this respect be a certain give-and-take between the chemist and his employers. It is quite easy for a chemist to do his work in a splendidly equipped laboratory, but his real value often lies in being able to obtain the necessary information without asking for expensive apparatus or a special laboratory building. This fact is frequently not realised by the academic chemist, but experience soon makes it clear to the industrial chemist, and the necessity for improvisation should be impressed upon all budding industrial chemists during their years of training.

If the work of the chemist lies in a testing laboratory he must consider what must be the order of accuracy of his results. It may be that he is working with materials in which 0.01 per cent. of certain impurities has a real significance. He must then consider whether the conditions of his laboratory will allow him to get this result, and if either the conditions or the appliances render the required degree of accuracy doubtful, he must insist that these conditions are rectified. It may be that the laboratory does not require anything like this degree of accuracy, but requires a few simple tests designed for process control; in these circumstances the chemist can work under much worse conditions.

During the thirty years with which the writer has been connected with laboratories a change has occurred in the general outlook to methods of testing. In former days there were frequently a certain number of recognised tests of a general character. That is to say, the methods of testing were not very precisely laid down and were passed on by word of mouth from one chemist to another. On entering a laboratory a chemist would be taught the methods generally used in that laboratory. They might be, and frequently were, designed for a particular industry. One always had the standard methods of analytical procedure for the estimation of the common elements; that was the groundwork of analysis, though the standard methods frequently had to be modified, as they have to-day, to meet the varied character of the impurities that might be met under industrial practice. What is here referred to is primarily not the recognised analytical procedure of this character, but the special tests required for specific industries, as, for example, the tests for tar and tar products or for coal for its value for carbonisation and so forth.

Secrecy

Under these circumstances each laboratory worked out its own tests. These tests might sometimes be described in the Transactions of Societies or in articles in the technical press, and to that extent chemists could borrow from each other's experience, but even so modifications would creep in and a firm would sometimes regard secrecy of this analytical procedure as imperative. The writer in those days was engaged in laboratory work on coal and has a lively recollection of just such an incident. Up to that time—well over 20 years ago now—the testing of coals for their probable behaviour in a coal washery where dirt was to be removed was always done by floating them in a solution of calcium chloride of specific gravity 1.4. This solution was messy to make up and difficult to keep at the required strength; unless the coal was carefully dried before being washed it was, indeed, impossible to keep it at the right strength. About that time the writer noticed that the specific gravity of minerals was frequently obtained by floating them in liquids of different densities such as bromoform. The idea immediately occurred to him that by using carbon tetrachloride, chloroform, and mixtures of these with toluene a wide range of washing liquids could be secured which would enable a very great deal more to be learnt about the washing properties of coal. He thereupon instituted this as a standard procedure in his laboratory and the result was

received with loud applause. A few weeks later the managing director met a friend who was a Professor in the technical department at the university and who happened to mention this procedure in conversation. There was a scene in the managing director's office next morning. "Why," he stormed, "have you disclosed our new methods of testing to Professor X?" In point of fact no such disclosure had been made; it was merely that the same idea, as so often happens, had occurred simultaneously to two people in the same industry. But the Great Man took a deal of convincing that this was actually what had happened, and until he was so convinced his wrath at this disclosure of what he considered private analytical methods was considerable.

Another difficulty in those days, and one which, of course, is still with us in the examination of many substances, is that there were to be found in literature several alternative methods for doing a given analysis, and these were not necessarily equally good. Anyone, for example, who has a copy of the late Dr. Mellor's magnificent "Treatise on Quantitative Inorganic Analysis" will obtain an insight into the diversity of methods employed in the ceramic industries and into the elaborate investigations that were made to determine the sources of error of these various methods.

In many directions all this has been changed to-day by the work of the British Standards Institution and other Committees set up for this specific purpose. It is recognised that an important part of the work in industrial laboratories is to obtain accurate and reproducible results as between buyer and seller. The difficulties of analysis under the old conditions, when each worker had his own special methods or might use different modifications of standard methods, has led to the standardisation of testing as a necessary adjunct to the standardisation of materials. There is no objection to the introduction of improved methods because the Standards are revised from time to time, and when a better method is available it can be put into the Standard. The effect on the chemist and his laboratory is to strengthen the hands of the chemist immensely, because, if a firm proposes to make goods to British Standards or to buy goods based upon British Standards, he is bound to employ the procedure and apparatus laid down in the relevant Standard for the method of testing.

Special Tests

One further change which, perhaps, is a necessary corollary of the growth of standards is the adoption of more special tests in industrial laboratories. Quite often special tests were introduced in the research laboratory in the first place, and when they had proved their value in clarifying some particular physical or chemical property of the materials tested, they were then introduced as routine tests into the works laboratory. Many of the methods of testing iron and steel, including the X-ray analysis of welding, come under this heading, and in most other industries examples will readily come to mind. This has generally necessitated the use of specialist and often expensive apparatus. The more this type of apparatus is laid down as essential in British Standards Specifications the stronger will be the need for properly equipped works laboratories.

(*Continued from page* 234.)

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PLASTICS FOR EXPORT

Signs of the drive the commercial world is making in order to maintain and increase exports come daily to light. News now comes from the PLASTICS EXPORTS GROUP, 11 and 12 Pall Mall, London, S.W.1. They have just published a catalogue especially for export; it is written in four languages and is in the form of a file, so that, as Sir Andrew Duncan says in the introduction, "New pages will be added and the fullest possible details will be sent to agents and sub-agents throughout the world." The catalogue will thus completely represent the exportable goods of the British plastics industry. Incidentally, joint agents and sub-agents have been allotted, each to a certain territory, so as to avoid competition among the members of the group; minimum selling prices have also been agreed to for the same reason. The scope of the goods advertised is wide. Table ware, furniture, and industrial mouldings, where phenolic plastics play a big part, are all included. Plastics in the future, it is claimed, will supply most of man's needs, and an article by V. E. Yarsley, D.Sc., F.I.C., goes so far as to suggest that the chief use of metal in days to come will be in the manufacture and fabrication of plastics.

LETTER TO THE EDITOR

Cheap Oxygen

SIR.—Your note in THE CHEMICAL AGE (44, 1134, p. 163) on "Physical Research in Russia," and Mr. Borchardt's letter in a later issue (44, 1138, p. 220) pointing out that the Kapitsa process is nothing more than a modification of the Linde-Fraenckl process, raises an important question which I hope Mr. Borchardt or another of your correspondents can answer authoritatively.

One of the most pressing needs in many industries is for cheap oxygen. The iron and steel industry are looking for cheap oxygen to enable oxygen to be used in place of air in operating a blast furnace. Russian fuel technologists are groping their way towards gasification of coal *in situ* in the mines, thereby saving most of the cost of mining and all the cost of treating and cleaning coal; but for this process to be economic they evidently require cheap oxygen in place of air or to enrich air. The gas industry would like to operate water gas plant by oxygen, and it will require cheap oxygen for the new total gasification plant now under examination, if this process proves to be economic. Similarly, there are many other branches of the chemical and allied industries where really cheap oxygen would lead to fundamental improvements in technical processes.

In your original note, it was stated that as a consequence of the new work being carried out by Kapitsa "there are grounds for believing that the Soviet Union will soon have at its disposal the cheapest industrial oxygen in the world." Mr. Borchardt states that a Linde-Fraenckl plant is in operation in this country, so that it seems evident that we have here sufficient experience to know what are the possibilities. In 1938, Mr. E. V. Evans (Institution of Gas Engineers, Communication No. 180) stated with regard to the cost of oxygen production that "in sufficiently large quantities, oxygen of a purity of 90 per cent. can be produced at between 6d. and 8d. per 1000 cu. ft. On a small scale the cost would probably be between 1s. 8d. and 2s."

The question then arises, has there been any development since then which will materially reduce these figures, and what prospect is there of any considerable reduction being obtained?—Yours faithfully,

G. E. FOXWELL.

London, S.W.1.
April 22, 1941.

A CHEMIST'S BOOKSHELF

PRINCIPLES AND PRACTICE OF CHROMATOGRAPHY. By L. Zechmeister and L. Cholnoky. Translated from the second German edition by A. L. Bacharach and F. A. Robinson. London: Chapman and Hall. Pp. 362. 25s.

The field of analytical chemistry has been enriched in recent years by a number of revolutionary techniques. One of the foremost of these is chromatography. The names of Zechmeister and Cholnoky are as indissolubly attached to this method as is that of Tswett, its inventor. A translation of the second German edition is doubly welcome at this time, since it makes easily available to English readers full information on the technique up to 1938.

The great successes of chromatographic adsorption in dealing with natural products tend to overshadow its advantages in other directions. This book reminds us that it can be applied to such problems as the separation of purification of synthetic dyestuffs, coal-tar hydrocarbons, and inorganic ions. An outstanding feature is the frequent stress laid on fields, so far relatively undeveloped, which promise well. This is particularly true of the industrial applications of the method, and a wide field for profitable investigation is offered to the industrial chemist. Since the authors cover every aspect of the subject, theoretical and practical, organic and inorganic, from micro to semi-industrial scale, the book is one which no chemist can afford to ignore

In the opinion of the reviewer the translation suffers from too literal rendering into a rather "German" English which tends to lack clarity. While it would be difficult to improve on the matter, the manner might have benefited by a more thorough remodelling of the final script. There can, however, be no divergence of opinion in assessing the service that the translators have rendered to English-speaking chemists by placing this work before them.

American Chemical Industry Statistics

20 out of 21 Companies Show Trading Proft

THE Securities and Exchange Commission of America has obtained statistical information of 21 American companies each with assets above $10,000,000 and representative of the large chemical manufacturers in the U.S.A. This has just been published for the year ending December 31, 1939 (*Chem. Met. Eng.*, 1941, 78), together with much information as to production, exports and imports in the whole of the chemical industry for the year 1940.

A detailed combined balance sheet for these 21 firms is given of which the following are the salient points. Values are expressed in million dollars. Sales for the year were 984; operating profit 179 or 18.2 per cent. of sales; and depreciation and depletion charges 62 or 6.3 per cent. of sales. Twenty firms reported an operating profit and one a loss. Combined profit after allowing for all charges including non-operating gains and losses, prior claims, interest, and income tax, was 189 or 19.2 per cent. of sales. Dividend paid was 149, of which 11 was current cash dividend on preferred stock and 138 was cash dividend on ordinary stock. Balance sheet assets were 1792 on December 31, 1939, compared with 1708 for 1938.

Of 28 firms making chemical and allied materials, 4 per cent. of the gross sales income was spent on research, a figure that contrasts sharply with 0.2 per cent. for American industry as a whole.

Some interesting combined balance sheet figures are given which show that of the sales for 21 companies of $983,841,000, cost of sales was 54.7 per cent., gross profit 45.3 per cent., repairs and maintenance 4.7 per cent., depreciation and depletion 6.3 per cent., and selling, general and administration expenses 2.5 per cent. of the sales value, making a net profit of 18.2 per cent., or 19.2 per cent. after allowing for all charges.

JET-TEST APPARATUS FOR METAL COATINGS

Another time-saving outfit marketed by British Drug Houses, Ltd., is the B.N.F. Jet-Test Apparatus. This was designed primarily for electroplating work, and by its use it is possible to determine in a few minutes the thickness of metal coatings on plated articles. The test was developed for the British Non-Ferrous Metals Research Association by S. G. Clarke of the Research Department, Woolwich. The method is based upon measurement of the time required for perforation of the metallic coating by a jet of an appropriate solution which is allowed to impinge on the surface at constant pressure and known temperatures. Solutions, together with time and temperature data, are available for nickel, copper, bronze, zinc, and cadmium coatings on steel, copper, brass, aluminium, and zinc basis metals. The apparatus has been most favourably received in the metal plating industry, and quite recently the series has been extended by the introduction of B.N.F. Jet-Test Solution No. 5 with its appropriate chart which is used for the local thickness measurement of silver coatings. The method, which has been devised by R. A. F. Hammond, is suitable for platings on basis metals consisting of steel, nickel, or nickel-silver, and is equally applicable for determining the thickness of silver deposited on amalgamated basis metals. From the foregoing it will be seen that, as the general interest in these convenient outfits develops, it becomes possible to extend the range of their utility.

Recent Advances in Laboratory Equipment

Vibrator for Test Sieves

SIEVING has always been an important operation in the chemical works laboratory and too often an unsuccessful one. Particles which should have passed through the mesh for some reason or another do not do so and consequently an imperfect segregation of the material results. Avoidance of this has been the aim of the PASCALL ENGINEERING CO., LTD., 11a West Central Street, London, W.C.1, in their development of the laboratory test sieve vibrator known as the "Inclyno." From a study of the most suitable mechanical motion for the task in view three essentials were established; speed of vibration, a rotary rocking movement, and a gyratory motion imparted to the actual material under treatment.

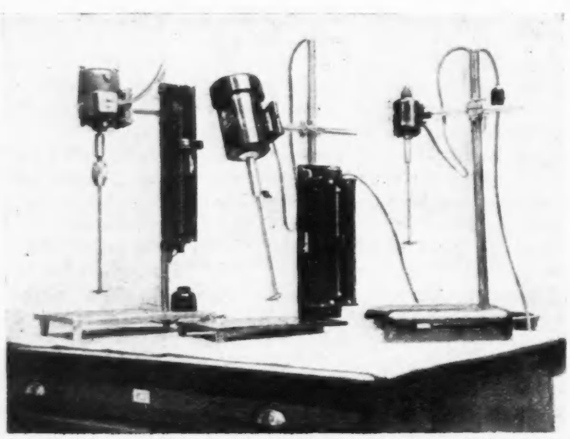
These movements have been incorporated into the mechanism of the sieve, doing away with several causes of inefficiency. Correct vibration speed makes the matter pass through the sieve without delay, while the gyratory rocking action ensures that the whole surface of the mesh comes into play at all possible angles, affording every particle, whatever its shape, the maximum chance of slipping through. Thus a perfect analysis is obtained.

Another advantage, possibly as great, is the fact that the machine is automatic. With hand sieves an operator is needed when he could be better employed elsewhere; the work is laborious and never completely successful, whereas the "Inclyno" is driven by a motor fitted with a time switch that automatically stops the unit within a time-range of from 5 to 90 minutes. The machine is adjustable for 6 in. or 8 in. sieves and follows modern practice of quiet running. A point to note is that the table carrying the sieves does not rotate, although the material on the sieves is given a rotatory motion.

Cabinets, Stirrers, and Acid Pumps

DRYING cabinets, made by L. A. Mitchell, Ltd., 37 Peter Street, Manchester, 2, and supplied for making tests, for small-scale production, sterilising, etc., are well known to readers of THE CHEMICAL AGE. They can be either steam heated or electrically heated, air inlets and outlets being fitted for humidity control. In addition, where desired, the cabinets are fitted with thermostatic control.

In addition, many other useful items of laboratory equipment are manufactured by this company. Laboratory mixers, for example, are supplied in two standard sizes, *i.e.,* fitted with a ¼ h.p. motor or with a 1/60 h.p. motor suitable for either A.C. or D.C. supply between 200 and 250 volts. The machines are complete with stainless steel agitator shaft and propeller, and arranged with adjustable sliding clamp by means of which the mixer can be raised or lowered. In the case, a speed controller is arranged so that the mixers can operate at high or low speed according to the nature of the product being handled. The units are also fitted with a three-speed cone pulley so that the motor can be utilised as an independent driving unit in the laboratory.

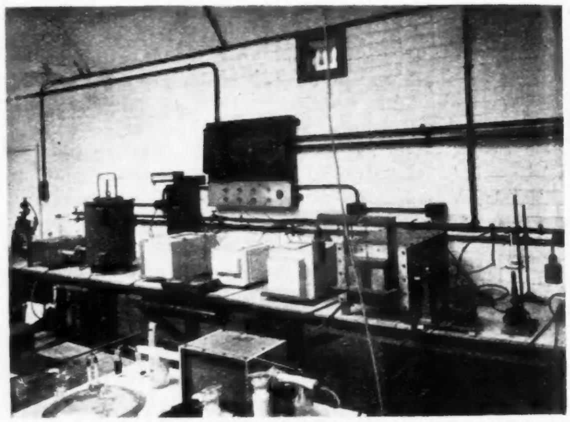


Small mixer units, designed for research work by L. A. Mitchell, Ltd.

An illustration opposite shows a Mitchell portable hand-operated pump of the diaphragm type in operation. The body of the pump is of special "Vitreon" Ware, manufactured by Messrs. Shanks, Ltd., Barrhead, for which L. A. Mitchell, Ltd., are the sole selling and distributing agents. The pump is fitted with a rubber diaphragm and valve, and is an indispensable unit for emptying carboys or pumping from elevated tanks, or for emptying tanks without a bottom run-off. It is of use also in war-time emergencies, should the power supply fail in an air-raid. The unit has a capacity of 350-450 gal. per hr., and can be supplied for belt drive or direct motor drive.

Electric Furnaces for the Laboratory

ELECTRIC furnaces play an important rôle in chemical laboratories. Among the foremost producers of such equipment must rank the firm of Messrs. Wild-Barfield Electric Furnaces, Ltd., Watford, Herts. In the electric furnaces section of their own chemical laboratory (an illustration of which is shown herewith) experiments are carried out with the aid of modern equipment and it is here that research work on furnace development, heat treatment, and bright thermal treatments take place before proceeding to the semi-technical plant in the demonstration shop. Among other plant, there is the usual standard horizontal muffle, adapted for ashing determination. It has a specially graded chamber winding, counterbalanced Elecfurnite doors at each end, and a silica chamber. It operates at temperatures up to 1000° C. and is controllable down to 200° C. Temperature control is effected in the usual manner by a variable pattern rheostat generally mounted on a control panel together with the main switch and fuses, ammeter, pilot lights, etc. There are two tube furnaces for carbon determination and a special vertical furnace housing a retort. This last has been designed for conducting experiments in controlled atmospheres. It is suitable for a maximum operating temperature of 1500° C. Hydrogen is introduced into the insulation to prevent oxidation of the molybdenum and for this reason the furnace is gas-tight. The hydrogen seeps through the refractory chamber where it forms a protective atmosphere. Additional inlets are provided at the extreme end of the coolers.



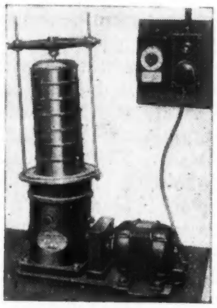
A corner of the Wild-Barfield chemical laboratory. A standard horizontal muffle furnace is seen on the right

Useful Laboratory Accessories

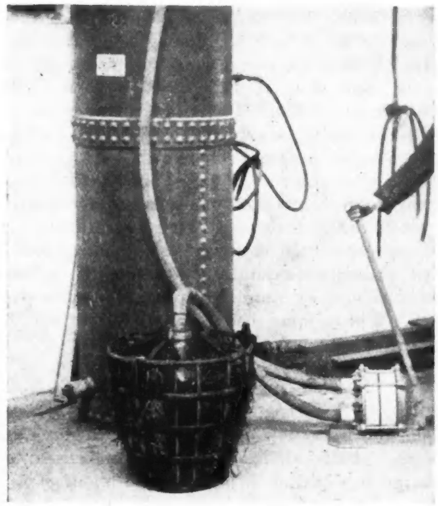
THIS war must be fought in the factories before it can be won in the field. Science is playing in it a part more important than in any other war in history. Griffin & Tatlock, Ltd., Kemble Street, London, W.C.2, are assisting science to develop the maximum war effort by the manufacture of instruments and apparatus of the modern type essen-

DEVELOPMENTS IN LABORATORY APPLIANCES

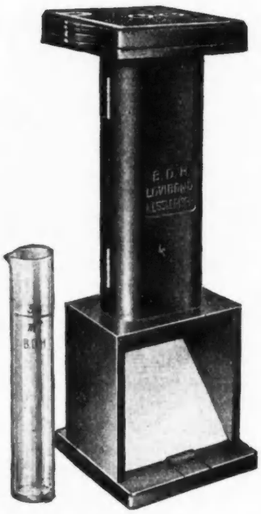
Four-six clamp manufactured by Griffin & Tatlock



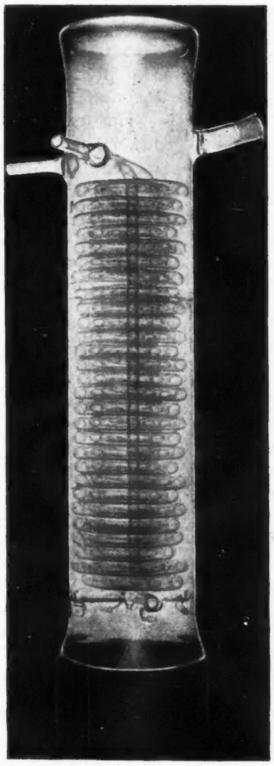
" In-clyno " test-sieve vibrator by the Pascall Engineering Co.



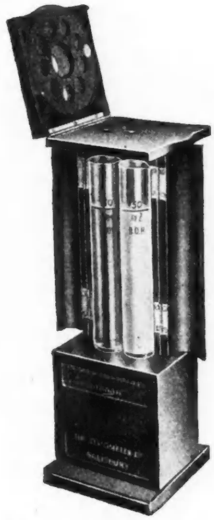
Small hand-operated portable pump made by L. A. Mitchell



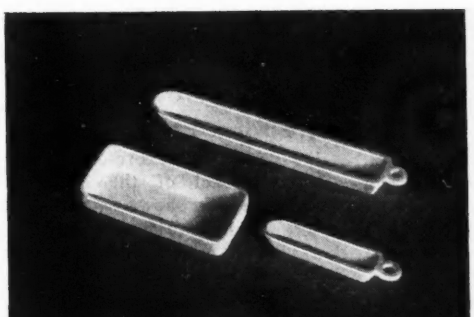
Lovibond Nessleriser by the British Drug Houses



A reflux condenser by Quickfit and Quartz



Interior of the B.D.H. Lovibond Nessleriser



Examples of alumina laboratory ware produced by the Thermal Syndicate

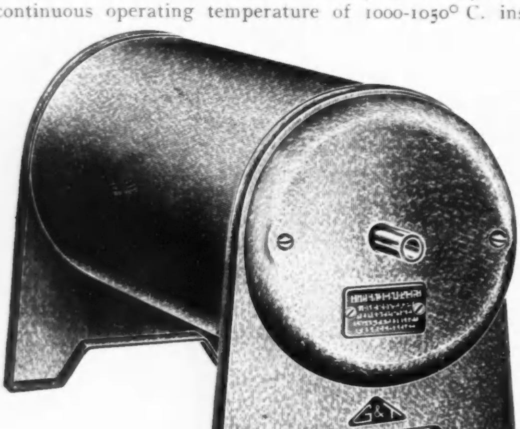
tial to modern science. Many newly-developed improvements are described in their latest catalogue and leaflets, and some of these are shortly reviewed here.

The Babcock Fuel Sampler has been developed to make more accurate the selection of a representative sample from crushed or powdered non-homogeneous substances. While devised primarily for use in the sampling of coal, it is equally applicable to grain, ore, etc.

The Griffin "Four-Six" Clamp is a new type, precision diecast in brass. Having a useful range of $\frac{1}{8}$ to $3\frac{1}{2}$ in., it fulfils all the purposes for which four sizes of clamp were previously required. It grips apparatus at six points, and has the notable merit of being inexpensive. A special point to note is that the stem is cast integrally with the stationary jaw, and, therefore, cannot become unscrewed during use—an important consideration when slight adjustments to an apparatus may be required after its assembly has been completed. The tommy bar is of generous length and cannot bite into the fingers.

A New Tube Furnace

MICROID laboratory tube furnaces are designed around an entirely new type of heater. The element consists of a special nickel-chromium wire embedded in magnesium oxide inside a nickel-chromium tube about 5/16 in. dia. This tube can be bent to any desired shape, circular, spiral or square. The wire heating element is kept out of contact with the atmosphere (and can consequently be run at a temperature higher than is common for elements of this type exposed to the atmosphere) and does not require a supporting tube. The Microid Tube Furnace, therefore, attains a continuous operating temperature of 1000-1050° C. inside



The Microid Laboratory Tube Furnace, by Griffin & Tatlock

the tube, and can be used for short periods at 1100° C. At a temperature of 1000° C. it has an extremely long life.

This is an electric furnace worth the closest consideration of every chemist, whether for use in carbon estimations in steel, or for any other laboratory purpose for which a tube furnace is employed.

B.D.H. Lovibond Nessleriser

AN ever-increasing number of laboratories include among their equipment a model of the B.D.H. Lovibond Nessleriser. As the illustration shows, it consists essentially of a bakelite case for holding two 50-ml. Nessler glasses in a vertical position between a reflector and a detachable rotating disc having nine apertures containing a series of graded permanent glass colour standards. Each disc constitutes a set of ready-made standards designed for a particular colorimetric test conducted under specified conditions. There are now available 30 discs embracing the practical working range of 17 colorimetric procedures and, in addition, eight discs for the determination of *p*H values which together cover a range from *p*H 3.6 to 11.0. The latest addition to this series is a disc for the colorimetric determination of nitrate using the popular phenol-disulphonic acid method. This has been produced in response to many requests, and its use renders the accurate determination of nitrate by this expeditious method even more simple. Although suitable for colorimetric work in any connection, the Nessleriser was primarily designed to simplify water analysis, and the magnitude of the success attained in this direction will be appreciated by the realisation that the complicated Winkler's test for dissolved oxygen can readily be conducted in the field with no other additional apparatus than a bottle and a couple of small pipettes.

All-Glass Chemical Plant

UP to recent times, the use of glass in a chemical plant has been regarded as an evil to be resorted to only when a suitable metal is not known, or is too expensive. War-time restriction of metal supplies has, however, led the plant designer to adopt the use of glass to an ever increasing extent. Anxious for an opportunity to prove that large scale glass plant could stand up to working conditions, Quickfit & Quartz, Ltd., 1 Albemarle Street, London, W.1, designed and produced a range of reflux and distillation condensers, fractionating columns, boilers, and pipe lines.

The use of heavy gauge material—heat-resisting glass of low thermal expansion—ensures maximum resistance to mechanical shock, while skilled manipulation followed by thorough annealing provides a finished product which is not itself subject to internal stress fracture.

Reflux Condensers consist of a cooling element in the form of an assembly of $\frac{1}{2}$ in. bore tubes sealed into a robust glass body, 6 in. or 9 in. in diameter. At the lower end is a stout flange having an internal diameter the full bore of the tubing used for the body. No restriction is, therefore, offered to reflux, and blocking with liquid is eliminated. The top of the condenser is either left open with a full diameter flange, or reduced down to (say) a 1 in.- or 2 in.-bore pipe flange.

Distillation Condensers are made on the aove principle, and may be fitted with adapters reducing the body diameter down to 1 in. or 2 in. pipe flanges at top and bottom, or the body itself may be reduced at each end to a small-diameter pipe flange. The former arrangement allows the condenser unit to be used both for reflux and distillation.

Fractionating Columns are made in 5 ft. 6 in. long units of any bore up to 6 in. or 9 in., fitted with full bore pipe flanges at each end. Reflux return and vapour take-off tubes may be fitted in any desired position.

Replacement of Continental Laboratory Ware

IT will be fully understood that the Thermal Syndicate, Ltd., Wallsend, Northumberland, cannot readily announce new forms of special Vitreosil equipment for laboratories at the present time. However, apart from the extensive use of Vitreosil ware to assist the national effort in many directions, they are manufacturing much special apparatus.

The production of Alumina laboratory ware, which was formerly only obtainable from abroad, is increasing. Further, the manufacture of vessels of other highly refractory oxides and mixtures is having every attention, and it may be expected that British made articles of this type will shortly be available to replace those of continental manufacture not now obtainable. In the meantime, readers may like to be reminded generally of the properties of Alumina ware, which are: it is almost pure recrystallised alumina: it has not the resistance to heat shock possessed by Vitreosil, but it can be used up to 1950° C.; it is resistant to many fused metals, oxides, salts and glasses; and it has an even higher electrical resistance at high temperatures than Vitreosil.

Alumina ware is made in two grades of porosity, high and low, the former being more resistant to heat shock. The makers will advise the most suitable grade on being told the conditions of use.

Personal Notes

MR. JOHN MERRY, A.I.C., was married at Kinnettles, Angus, on April 19 to Miss Anne Shiells of Douglastown, Forfar.

MR. T. BIDDULPH SMITH, manager of the coke-oven and by-product plant of Messrs. Dorman Long and Co., Ltd., Grangetown, has been elected president of the Cleveland Scientific and Technical Institution, Middlesbrough.

MISS CONSTANCE MABEL HOLDSWORTH, daughter of Mr. Ernest F. Holdsworth, a director of the Bradford Dyers' Association, was married at the Church of St. Mary Magdalene, Bradford, last week, to Captain Enoch Davies, C.F.

MR. G. S. RANSHAW, a frequent contributor to THE CHEMICAL AGE, has been appointed a director of Portland Designs, Ltd., designers of printed fabrics, 3 Chepstow Street, Manchester. He is now engaged in developing an entirely new series of technical war-time services, of which the industrial photomicrographic section is already launched.

OBITUARY

PILOT OFFICER CHRISTOPHER JOHN DRAKE ANDREAE, R.A.F.V.R., who was reported missing on August 15, 1940, and is now officially presumed killed in action, was the younger son of MR. FRANK G. ANDREAE, director of Quickfit and Quartz, Ltd., laboratory and scientific apparatus manufacturers, of London and Kings Norton.

DR. GEORGE WILLIAM CLARKSON KAYE, D.Sc., F.R.S., who died on April 16, aged 61, had been superintendent of the physics department of the National Physical Laboratory since 1922. He was known to a wide scientific sphere on account of his delightful and erudite lectures, not only before the Royal Institution (of which he was twice a visitor and manager) and the Royal Society of Arts, but also to bodies more purely connected with physics.

LORD STAMP, G.C.B., G.B.E., D.Sc., whose death at the age of 60 by enemy action was announced on April 17, included connections with the chemical industry among his extraordinarily widespread activities, scientific and otherwise. From 1919 to 1925 he worked as secretary and director of Nobel Industries, Ltd.; and when that concern was amalgamated in 1927 with the I.C.I. he became a director of the latter company. He served on the governing bodies of the London School of Economics, Birkbeck College, and University College, Aberystwyth, and he was a vice-president of the National Institute of Industrial Psychology. He was chosen as President of the British Association in 1936. The story of his work as adviser to the Government during the war cannot yet be revealed.

New Control Orders

Steel for Industrial Alcohol Plant

HITHERTO, applications for steel authorisations have been addressed to the Government Department under whose responsibility the steel was to be used. From now on, applications from certain raw material industries will be dealt with by the appropriate Controller.

In the case of molasses and industrial alcohol, application forms for authorisations of steel for the manufacture of new plant and machinery; the maintenance and repair of existing plant; and packages and containers, to be used in processes of manufacture of molasses and industrial alcohol, can be obtained from the Molasses and Industrial Alcohol Control, Great Burgh, Epsom. The processes referred to are: the storage and distribution of molasses; the production storage and distribution of methyl alcohol (including wood naphtha); of industrial ethyl alcohol; of amyl alcohols (including fusel oil); of hexyl alcohols; of acetic acid and esters of acetic or acetoacetic acids; of ethyl lactate; of ethyl, butyl and amyl phthalates; of esters, ethers or ether esters of ethylene and diethylene glycols; of acetone, methyl ethyl ketone and diacetone alcohol; of formaldehyde (including hexamethylenetetramine).

Zinc Bromide Exempt from K.I.D.

The Treasury has made an Order under Section 10 (5) of the Finance Act, 1926, exempting zinc bromide from Key Industry duty. The Order is effective from April 18 until June 30, 1941. Copies of the Order, which is entitled "The Safeguarding of Industries (Exemption) No. 2 Order 1941," may be obtained from H.M. Stationery Office.

Export of Mica and Sulphur Manufactures

The Board of Trade has made the Export of Goods (Control) (No. 14) Order (S.R. & O. 1941, No. 492, price 1d.) which came into force on April 24, by which the Export of Goods (Control) (No. 39) Order, 1940, is amended as follows:—

(i) Licences will, in future, be required to export to all destinations: Vitamins A, B1 and D, separately or admixed; vitaminised oil and emulsions and mixtures thereof; manufactures of mica; mixtures of sulphur; certain classes of machinery; and vegetable tanning materials. Licences will be required to export insulating materials containing mica to certain specified destinations.

Limitation of Supplies

The Board of Trade has announced the quotas for the next restriction period under the Limitation of Supplies (Miscellaneous) Order, *i.e.*, June 1 to November 30, 1941. The standard period on which the quotas will be based will be the same as for the first Miscellaneous Order, namely, June 1 to November 30, 1939.

Liquid Glucose Prices

The Minister of Food, by the Liquid Glucose (Maximum Prices) Order, 1941 (S.R. & O. 1941, No. 510), establishes the maximum prices for liquid glucose sold by a manufacturer or distributing agent as follows:—

	[per cwt.] s.	d.
In tanks containing 2 tons or more net weight...	44	6
In barrels containing 3 cwt. or more net weight	46	4½
In drums containing 5 to 6 cwt. net weight ...	45	9
In drums or pails containing 1 cwt. net weight...	46	1½
In tins containing 56 lb. net weight	48	6
In tins containing 28 lb. net weight	50	3
In tins or jars containing 14 lb. or less net weight	52	0

An increase of 6d. per cwt. net weight is allowed on a sale (a) by a manufacturer to a person buying otherwise than for the purpose of resale or to a person buying for the purpose of the manufacture or preparation by him of any other article; (b) by a distributing dealer in the original container in which the liquid glucose was supplied to him by the manufacturer.

Conditions relating to small lots and higher or lower density are the same as in the previous Order, reported in THE CHEMICAL AGE, 1941, *44*, 1125, p. 48.

SPECTROCHEMICAL ABSTRACTS

The second volume of "Spectrochemical Abstracts" recently published by Adam Hilger, Ltd., covers the years 1938-1939 and includes books published in 1940. The author, Mr. Ernest H. S. van Someren, B.Sc., is to be complimented on the presentation of the entries in this invaluable handbook. In such a work ease of reference and completeness are the most important considerations, and the system of arrangement ensures that the first of these is carried out to a nicety. As to completeness, only a cursory test is possible in the time at our disposal; it is sufficient to say that the handbook has stood up completely to any ordeal that we have been able to apply.

A VALUABLE SOURCE OF vitamin C has been discovered in the needles of pine and spruce trees and juniper bushes. This discovery was made recently by Dr. Ragnar Larson, of Gothenburg, Sweden, who reports that the pine needles contained the largest amount of ascorbic acid.

CONSTRUCTION WORK IS PROCEEDING on an ammonia plant near Calgary, Alberta. The initial plan was to produce 150 tons of ammonia daily, but because of insufficient power the daily output was modified to 100 tons. The difference of 50 tons daily will be covered by new plants in eastern Canada.

General News—From Week to Week

A DONATION of ten guineas has been made to the Manchester Technical Library Fund by the Clayton Aniline Co., Ltd.

VITAMINS, VITAMIN CONCENTRATES, and vitaminised oils are regarded as put up for medicinal use and as chargeable with Purchase Tax when they are put up for use by injection, but not otherwise, states a notice issued this week by the Customs and Excise authorities.

CHARLES GRIFFIN AND CO., LTD., have just published an important work on spectrochemistry by F. Twyman, F.R.S., managing director of Adam Hilger, Ltd. The work is entitled "The Spectrochemical Analysis of Metals and Alloys"; it is illustrated, and the cost is one guinea.

THE THOUSAND EMPLOYEES of Brotherton and Co., Ltd., chemical manufacturers, whose Yorkshire headquarters are Leeds and Wakefield, will each receive a War Saving Certificate —a gift from Mr. Charles Brotherton to mark the birth of his son and heir, David, who was born at The Hall, Kirkham Abbey, on April 20.

ABOUT 70 WORKERS of the Industrial Welfare Society have finished their training at universities and are available to take up appointments in factories. The course, which usually extends over one of two years' social science training, was conducted in three months. Another batch of candidates has begun a similar course.

STRAW PULP PLANTS INSTALLED on farms by I.C.I., Ltd., since the beginning of the year now number 250. This process, developed for making better food out of straw for animals, has become increasingly popular of late. Straw pulp is a palatable starchy food suitable for cattle, horses, or sheep, and can be used in a ration in place of roots.

A NEW METHOD OF ANALYSING the properties of coal was described by Mr. C. E. Spooner to the South Yorkshire Section of the Institute of Chemistry at the Sheffield Metallurgical Association on Monday. The method, needing only simple apparatus common in steel laboratories, determines carbon and hydrogen content in coal and coke in less than an hour. Sulphur and chlorine content are determined at the same time. Mr. B. W. Methley, chairman of the section, said that the application of chemistry to Sheffield industries was of vital importance.

THE TRADING WITH THE ENEMY (Specified Persons) (Amendment) (No. 5) Order, 1941 (No. 458 of 1941) contains 176 additions to and a few deletions from the previous lists of persons and firms in neutral countries with whom trading is illegal. Additions of chemical interest include the Drogueria Cosmopolita S.A., Av. Pino Suarez and Plaza Constitucion, Mexico City; Productos Medicinales y Farmaceuticos S.A., Calle de Ramon Guzman 61, Apartado 1074, Mexico D.F.; Soc. Comercial de Resinas, Ltda., Rua do Ouro 140, Lisbon; Resinas Sinteticas Españolas, S.A., and Union Quimica del Norte de España, S.A., both of Buenos Aires 4, Bilbao; and Ipsa A.-G. für Petroleum-Industrie, Rothkreuz, Zug, Switzerland.

RECENT ACTIVITIES OF THE PLASTICS GROUP of the Society of Chemical Industry include a joint meeting with the Bristol Section held on Thursday evening in Bristol University Chemical Department, and another joint meeting, this time with the Birmingham and Midland Section, held on Saturday morning in the Midland Hotel, Birmingham. At the Bristol meeting Dr. C. G. Addingley read a paper on "Some Aspects of the Use of Asbestos in Plastics." The paper at the Birmingham meeting was entitled "Formaldehyde," and the reader was Mr. H. W. Homer, of Synthite, Ltd. This meeting was followed by the annual business meeting of the Section and by a luncheon of the Midland Chemists' Committee at the Midland Hotel.

THE MINISTRY OF AIRCRAFT PRODUCTION has issued Material Specification D.T.D. 481, covering nylon cordage. The specification includes standards of quality and manufacture, weight, freedom from impurities, strength, and selection of test samples. It is laid down that the constituent yarn shall have a construction of six turns per inch, and a tolerance of $\pm$ 1. The weight of cordage shall not be less than 70 yards per lb., and no sizing or weighting material can be included. Appendix I deals with a method for the determination of weight; Appendix II with a method for the determination of breaking strength, in accordance with which the breaking strength of any specimen shall be not less than 400 lb. Copies of the specification can be obtained from H.M. Stationery Office, price 6d.

Foreign News

DR. HOWARD CRAMER, of the Department of Chemistry, Akron University, is reported as having estimated that plant to produce 100 tons of synthetic rubber a day would cost £2,500,000 and that to meet the U.S.A. normal annual consumption of 600,000 tons would require factories costing £41,500,000.

TYPE FACES MADE FROM RESIN obtained by interpolymerising styrene with acrylic or methacrylic nitrile are reported to have been produced in Germany. The type is said to be hard, tough and insoluble in the fluids usually used for cleaning type. The resin is much lighter than metal type, gives a sharp impression, and can be recast.

THE LUOSSAVAARA-KIIRUNAVAARA A/B has erected a flotation plant at Malmberget for the production of apatite concentrates. Initial production is at the rate of from 20,000 to 25,000 metric tons annually, but the plant is to be expanded. The domestic apatite will serve as a partial substitute for imported phosphate rock. This development is the outcome of many years' research work undertaken by the company.

THE MANUFACTURES DES GLACES ET PRODUITS CHIMIQUES DE SAINT-GOBAIN has decided to use the net profits for the year 1939-40 as reserves for war losses, and no dividend has been distributed. The company's subsidiaries, particularly in Belgium and Holland, have also been affected by war conditions, but production by the Swiss subsidiary showed an increase.

ARGENTINA IMPORTED 10,732 tons of calcium carbide in 1940 as compared with 7463 tons in 1939. Brazil supplied 116 tons of carbide in 1939, but otherwise all the carbide requirements came from Europe until May of last year. In 1940 Brazil supplied 115 tons of carbide and from May onwards Canada supplied 1544 tons, the United States 656 tons, and Mexico 182 tons. Import permits for carbide are available without restriction, irrespective of the country of origin.

IMPORTS OF CHEMICAL PRODUCTS into Brazil in 1940 amounted to £1,714,000, as compared with £1,846,000 in 1939. Exports of carnauba wax rose from £802,000 in 1939 to £1,091,000 in 1940. Significant changes in trade figures show that whereas imports from Great Britain declined only from £2,951,000 to £2,873,000, those from the rest of Europe (excluding Portugal and Spain) declined from £11,294,000 to £3,034,000. Exports to Britain rose from £3,587,000 to £5,543,000; those to the rest of Europe (excluding Portugal and Spain) fell from £13,231,000 to £4,443,000.

AN ARGENTINE COLLOID CHEMIST, Dr. Christian Paul, claims to have manufactured a concrete far superior to anything yet produced and comparing favourably in strength with granite. Pulverised ores of low mineral content, when mixed with water by his method form the perfect concrete, according to his statement. The powdered ores are agitated at exceptionally high velocity by means of two powerful jets of water, which reduces them to a very fine powder. This powder is then allowed to set and to form a concrete harder and more resistant than anything yet produced.

THE OIL CONTROLLER of the Canadian Department of Munitions and Supply has completed an investigation into the market demand for lubricating oils, as well as the present production capacity in Canada. On the strength of this survey, he has authorised the construction by the British American Oil Co., Ltd., of a lubricating oil plant. This plant will have a capacity equal to that of the company's present market requirements in lubricating oils, and with excess capacity, to take care of additional demand. When the plant is completed there will then be three sources of lubricating oil in Canada.

FIFTY-NINE CHEMICAL MANUFACTURING CONCERNS are now operating in India, states a recent report of the Indian Chemical Manufacturers' Association, Calcutta. Bengal leads with 20 companies, Bombay has 14, the United Provinces 7, Punjab and Madras 5 each, Mysore 3, Bihar 2, and 4 are located in the other provinces and Indian States. One firm in Kathiawar has undertaken the production of soda ash and another in Mithapur near Port Okha (also in Kathiawar) is now erecting the necessary plant for the manufacture of soda ash, caustic soda, sodium bicarbonate, bleaching powder, liquid chlorine, bromine, zinc chloride, and other chemicals.

Forthcoming Events

The Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, is holding two Dr. Mann Lectures on April 28 and May 5 at 2.30 p.m. Dr. G. S. Whitby, Director of the Chemical Research Laboratory, Teddington, will speak on the subject of "Chemotherapy."

The 47th James Forrest Lecture of the Institution of Civil Engineers, Great George Street, London, S.W.1, will be delivered on April 29, at 1.30 p.m., when Professor E. N. da C. Andrade will talk on " The Mechanical Behaviour of Solids."

A concentrated three-day course of lectures, demonstrations and films on the organisation and methods of industrial training will be given at the National Institute of Industrial Psychology, Aldwych House, London, W.C.2, from April 29 to May 1. This follows a successful course on the organisation of war-time training of industrial workers held during March. The course is open to nominees from firms. The fee for one representative will be five guineas and for two from the same firm seven guineas.

A joint meeting of the Coke Oven Managers' Association and the Institute of Fuel will be held on April 30, at the Royal Victoria Station Hotel, Sheffield, at 2.30 p.m., when Dr. E. W. Smith (Woodall-Duckham Companies) will present a paper entitled "Research and the Coking Industry," to be followed by a discussion.

The next meeting of the Colour Group of the Physical Society will be held at 2.30 p.m. on April 30, at the Royal Photographic Society, 16 Prince's Gate, London, S.W.7. Mr. H. W. Ellis, B.Sc., F.I.C., will demonstrate the samples illustrating his paper on "Colour Tolerance" which he read at the meeting held on February 12. A paper on "Colour Terminology" will be read by Mr. H. D. Murray, M.A., F.I.C.

The annual meeting of the members of the Royal Institution, 21 Albemarle Street, W.1, will be held on May 1, at 5 p.m.

The B.A.C. London Section's annual meeting will be held on May 3 at the Café Royal, Regent Street, W.1, at 3 p.m.

A joint meeting of the Institution of Chemical Engineers and the Chemical Engineering Group (Society of Chemical Industry), will be held on May 13, at 2.30 p.m., in the rooms of the Geological Society, Burlington House, Piccadilly, London, W.1, when a paper on "Economical Raising of Steam in Small and Medium-size Boiler Plants" will be presented by Dr. G. W. Himus, Ph.D. The chair will be taken by the president of the Institution, Mr. C. S. Garland.

British Chemical Prices

Market Reports

A moderate business has been transacted in general chemicals during the past week and most sections of the market report a steady volume of inquiry. As regards contract deliveries the movement into consumption has been on a good scale and the supply position generally remains fairly steady. Prices throughout are well held at recent levels, the tendency if anything being towards higher rates. Acetic acid is active and available parcels of oxalic, tartaric and citric acids are promptly taken up. The recent improvement noted in the coal tar products section has been maintained and a fair amount of activity has been reported. Carbolic acid crystals and cresylic acid are both in good demand whilst solvent and heavy naphtha continue to enjoy an active interest. With few exceptions quotations are steady and firm.

Manchester.—Whilst the demand for contract deliveries of the alkalis and other leading heavy chemicals for users in the Manchester district continues on reasonably steady lines, actual new bookings during the past week have been no more than moderate for the most part, though in some directions buying interest has been maintained on an active scale. The general price tendency remains firm. Most of the tar products are the subject of a brisk inquiry, with crude tar, creosote oil, cresylic acid and solvent naphtha and other light materials prominent. A fresh upward movement of prices in the xylols and the naphthas has to be recorded.

Glasgow.—Business in general chemicals for home trade has been rather quiet since our last report, though there has been a fair inquiry for export. Prices continue very firm, and where altered, are rather dearer. Oxide of chromium has been increased 2d. per lb., making the revised price for approved orders 1s. 6d. per lb. net in original casks. Prussiate of potash remains very firm, but business is difficult to arrange on account of the limited supplies available.

Price Changes

Antimony Sulphide.—Golden, 10d. to 1s. 2d. per lb. Crimson, 1s. 8½d. to 2s. per lb.

Barytes.—Best white bleached, £8 3s. 6d. per ton.

Carbolic Acid.—Crystals, 9½d. to 10¾d. per lb.: Crude 60's 3s. 3d. to 4s. 3d., according to specification.

Carbon Black.—5¼d. to 8½d. per lb., according to packing.

Cream of Tartar.—100%, 252s. per cwt., less 2½%, d/d in sellers' returnable casks.

Cresylic Acid.—Pale, 99/100% 2s. 3d. to 3s. per gal. Manchester: Pale, 99/100% 2s. 8d. per gal.

India Rubber Substitutes.—White, 6d. to 8¾d. per lb.: dark, 5⅝d. to 8¼d. per lb.

Methyl Acetone.—40.50%, £54 per ton.

Naphtha.—Solvent, 90/160°, 2s. 3d. to 2s. 6d. per gal.; heavy 90/190°, 1s. 7d. to 1s. 8d., naked at works. Manchester: 90/160°, 2s. 4d. to 2s. 7d.

Pyridine.—90/140°, 17s. per gal.; 90/160°, 13s. 6d.; 90/180°, 4s. to 5s. per gal.; f.o.b. Manchester: 13s. to 17s. per gal.

Vegetable Lamp Black.—£45 per ton.

Wood Tar.—£4 to £5 per ton, according to quality.

Xylol.—Commercial, 3s. 6d. per gal.; pure, 3s. 8d. Manchester: 3s. 4d. to 3s. 9d. per gal.

Chemical and Allied Stocks and Shares

Subdued conditions have again ruled in the stock and share markets, awaiting the outcome of the latest phase of the war, but sentiment continued to be assisted by the absence of any heavy selling. In fact, at the time of writing a firmer undertone appears to be developing under the lead of British Funds, which benefited from the belief that a large part of the proceeds arising from the further requisitioning of American dollar securities will probably be reinvested in stocks of the gilt-edged class. Industrial securities showed no very definite trend, and the majority of movements were small and unimportant. It is being pointed out that E.P.T. at 100 per cent. will rule for the whole of the current year, and that having regard to the weight of taxation, dividend payments are likely to be lower in future. In the case of companies actively engaged in work essential to the war, however, dividend payments in many instances may show only small reductions, bearing in mind that they are likely to operate to capacity. Moreover, in cases where the E.P.T. standard is favourable, it may be possible to maintain dividend payments.

Imperial Chemical at 29s. were little changed, allowing for the fact that the quotation is now " ex " the final dividend, and the preference units were steady around 33s. 6d. The company has a satisfactory E.P.T. standard so far as can be judged, and the market is hopeful that it may be possible to keep the dividend at around 8 per cent. during the period of the war. Lever & Unilever were easier at 21s. 9d. awaiting the financial results for the past year's working, which are due shortly, and British Oil & Cake Mills preferred ordinary shares at 37s. 6d. have lost part of their recent rise. Dunlop Rubber were easier, pending the dividend announcement, expected next month, while small declines were shown by various other leading industrial securities, including Turner & Newall, Murex, and Wall Paper deferred. British Aluminium, however, were steady at 39s. 6d. and Borax Consolidated deferred were little changed at 28s. 6d., while the units of the Distillers Co. maintained the better tendency in evidence since the Budget speech. United Molasses were 22s. 6d.; the current market view is that there are reasonable possibilities of the dividend being maintained. British Match were unchanged at 29s. 9d. despite the lower earnings of the Bryant & May subsidiary.

In other directions, Associated Cement were 48s. 9d., but Tunnel Cement were firm at 33s. 9d. xd on the good impression created by the results and the statements at the meeting. Moreover, British Plaster Board 5s. shares continued to be quoted at 13s. 3d. in response to the favourable dividend estimates current in the market. Iron and steel securities were lower, it being pointed out that most companies in the heavy industries have an unfavourable E.P.T. basis, and that as E.P.T. remains at 100 per cent., and the standard rate of income tax is to be increased to 10s., somewhat lower dividends seem probable. Nevertheless, yields at current prices are substantial in many instances, and the shares would seem to be undervalued in relation to those of numerous companies not playing an essential part in the war effort. Dorman Long were 17s. 4½d., Staveley 44s. 6d., United Steel 21s. 4½d., and Stewarts & Lloyds 42s. 3d. Tube Investments were fairly steady at 89s. 3d. on expectations that the forthcoming interim dividend will be maintained.

B. Laporte remained at 60s. awaiting the annual results, and Fison Packard were again 32s. 6d., while Greeff-Chemicals Holdings 5s. units were quoted at 5s. 7½d. and Monsanto Chemicals 5½ per cent. preference at 22s. 6d. Boots Drug were steady at 35s., awaiting the dividend announcement due next month. Beechams Pills deferred were firm at 8s., and British Drug Houses 22s. 6d. Oil shares were again lower on balance, in accordance with the general tendency on the Stock Exchange.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

PREMIER COAL-OIL DEVELOPMENT PLANT, LTD., London, S.W. (M., 26/4/41.) Jan. 1, bond, etc., securing £8000 to Baron Brocket; charged on land at New Cumnock. *Nil. Mar. 28, 1940.

SILICA GEL, LTD., London, W.C. (M., 26/4/41.) Mar. 28, charge to Midland Bank, Ltd., securing all moneys due or to become due to the Bank; charged on contracts. *Nil. Dec. 31, 1939.

LONDON TESTING LABORATORY, LTD.—(M., 26/4/41.) Mar. 19, £950 debenture to N. C. Joseph, Ltd.; general charge. *Nil. Dec. 31, 1940.

Satisfactions

WADDICOR (BRADITS), LTD. Bethesda, enamel manufacturers. (S., 26/4/41.) Satisfaction, Mar. 26, of mortgage registered March 31, 1936.

PALLAS OIL AND TRADING CO., LTD., London, E.C. (S., 26/4/41.) Satisfaction April 1, of mortgage registered Feb. 16, 1940.

MENDIP OXIDE AND OCHRE CO., LTD., Wick, near Bristol. (S., 26/4/41.) Satisfaction Mar. 31, £2,000, registered Feb. 16, 1928.

County Court Judgments

TRAVIS, SIDNEY H., 11 Rylett Crescent, Shepherds Bush, manufacturing chemist (trading as S. H. Travis and Co.) (C.C.J., 26/4/41.) £28 15s. 11d. Jan. 28.

Companies Winding-Up Voluntarily

MINERAL OILS EXTRACTION, LTD. (C.W.U.V., 26/4/41.) That the Company be wound up voluntarily. James Young Finlay, High Holborn House, 52 High Holborn, London, W.C.1, Chartered Accountant, appointed Liquidator.

METAL & ELECTRO CHEMICAL PRODUCTS, LTD. (C.W.U.V., 26/4/41.) By special resolution, April 2, Mr. Hugh Wylie, C.A., 32, Old Jewry, London, E.C.2., be appointed Liquidator.

Company News

British Celanese, Ltd., are paying on April 30 a half-year's first preference dividend of 7 per cent. (same).

Breedon & Cloud Hill Lime Works, Ltd., are paying no dividend on the ordinary shares (same).

William Briggs and Sons, Ltd., announce an interim dividend of 2½ per cent. on the ordinary shares for year ending September 30, 1941 (same).

William Blythe & Co., Ltd., whose dividend we recorded last week, announce a net profit for 1940 of £36,756 (£31,753), and a carry-forward of £2443 (£2349).

The United Turkey Red Co., Ltd., report a profit for 1940 of £20,587, as against a loss of £76,788. The debit carried forward is reduced from £173,509 to £152,922.

The British Xylonite Co., Ltd., whose dividend we reported in a recent issue, announce a gross income of £84,057 (£94,026), and a carry-forward of £51,683 (£47,461).

The Indestructible Paint Co., Ltd., have declared a final dividend on ordinary shares of 12½ per cent., making 20 per cent. (25 per cent.).

Evans, Sons, Lescher and Webb, Ltd., report a dividend on preference shares of 9 per cent. actual, being 1½ years' dividend on account of arrears (the same). Net profit for 1940 was £28,889 (£30,984) and carry-forward is £14,262 (£12,885).

African Explosives and Industries, Ltd., fertiliser manufacturers, have declared a final dividend of 5 per cent. (making a total of 30 per cent. for the year), and a bonus of 7½ per cent., both free of Union income-tax.

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